

Decisions for Irrigation with Climate Fluctuation

Battelle Pacific Northwest Division

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Annual Progress Report #1

Abstract

Using a case study of the Yakima River Valley in Washington State, previous work has shown that relatively simple tools can be used to predict the impact of the El Niño phenomenon on water supplies to irrigated agriculture, that this information could be used to estimate the significantly shifted probability distribution of water shortages in irrigated agriculture during El Niño episodes, and that these shifted probabilities can be used to estimate the value of exchanges of water between crops to relieve some of the adverse consequences of such shortages under western water law. The current project will refine the process for conveying El Niño-Southern Oscillation (ENSO) forecasts for advanced planning of river management and irrigation seasons. Are applying lessons learned by ourselves and by others in the NOAA HDGCR program on successfully using climate information to assist practical management of resources. In a series of workshops, we will work with the Bureau of Reclamation Upper Columbia Basin Office (also called the Yakima Project Office: hereafter, Reclamation), irrigators, climate experts, the Washington State Department of Ecology (which manages the issuing and transfer of water permits), and other stakeholders to improve planning for drought conditions in the basin. The project also will experiment with web-based and in-person methods (workshops) to better manage and make more useful the dissemination of climate forecast information in predicting and managing water resources.

Using a reservoir model and probabilistic unregulated flow forecasts that vary by ENSO state, we will derive proforma state-dependent rule curves for reservoir operations that satisfy flood control, irrigation water availability (including crop production economics) and instream flow objectives. Modifying rule curves according to ENSO/PDO state is expected to reduce the risk to junior irrigation interests facing specific levels of water prorationing. We plan to hold a series of intensive hands-on workshops with Yakima River basin stakeholders based on the principles of the convergence and collaborative learning approach for the purpose of information exchange and training in climate-variability-sensitive water management and revealing participants' information preferences and use. Workshop participants will be asked to develop and explain competing plans for coping with the climate forecasts, using the modeling tools. We will collect data on the role of information in the planning and response process in the workshops, with probes based on the key issues identified in the literature concerning the use of scientific information and analysis in policy making and individual decision making

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Project Funds Received at Battelle: 08/04/2003

Progress During 2003:

Preparations are well under way for the first of the stakeholder workshops to be conducted under this grant at Heritage College campus in Toppenish, WA. Late receipt of project funds and resulting late actual project start has altered the first year schedule. Because we had planned the workshops during the winter and early spring when a comparative lull in farm field work makes attendance at workshops easier for water managers and irrigators, it is questionable whether more than one workshop can actually be held before the end of the first research year. At least one workshop will be held during the first project year.

Task 1. Modeling Lessons for Reservoir Operations /In-Stream Flows

We currently use a reservoir model and operating rule curves that satisfy flood control, irrigation water availability (including crop production economics) and instream flow objectives to converting these unregulated flows into goal-satisfying regulated flows in a probabilistic framework. Modifying rule curves according to ENSO/PDO state is expected to reduce the risk to junior irrigation interests facing specific levels of water prorationing.

Progress: We have spent time with the reservoir model examining scenarios for the operating rule curves, both for the historical time period and a warmer climate typical of El Nino years. The current operating rule being investigated follows the Bureau of Reclamation procedure of using the accumulated snowpack and typical climate years to forecast the water available for irrigation. The current method appears to be very conservative—it forecasts more serious drought than actually occurs. Resampling the historical record of reconstructed streamflows is being used as a technique to develop adequate sample sizes for analysis of different climate stakes.

The Board of Joint Control appears to be active only during periods of drought. We have identified members of the Board who have an ongoing interest in the drought management topic and are assembling lists of issues and questions to be discussed.

Preliminary analysis has been performed of additional storage on the probability of prorationing and has been developed into a simple spreadsheet model of the Yakima Project. This basic model has the flexibility to analyze the consequences of different levels of water storage and in-stream flow requirements for irrigators. It appears that the largest storage project being discussed for the system has the capacity offset the impacts of the worst droughts on record and future climate warming-related drought. It is not yet clear what the institutional issues would be related to inter-basin water transfers, or whether the project would be cost-effective.

The reservoir model also has been exercised with 20 percent additional storage. The additional storage significantly reduces the average number of days during which water must be prorated. Reducing water demand by 20 percent has an even larger impact.

Task 2. Modeling Detailed Lessons for Farms and Water Management Operations

We plan to hold a series of four intensive hands-on workshops (2 per year), for information exchange and training in climate-variability-sensitive water management. In preparation for the workshops, project personnel are undergoing Human Subjects Research training, as mandated by our Internal Review Board and developing and vetting workshop materials.

An important outcome of the workshops is expected to be guidance to Bureau of Reclamation, Washington Department of Ecology, irrigation districts, and farmers on how to use NOAA forecasts to help manage drought. Holding the workshops over two years allows the Battelle team to provide ongoing feedback to the stakeholders on technical issues as well as to begin to develop institutions to more successfully manage the consequences of climate variability in the basin.

Progress: We have prepared an agenda and plan for the first workshop, a potential list of participants for the first workshop, and a list of issues to be covered, and have secured a location (Heritage College campus in Toppenish, WA). The first workshop will be devoted to reservoir management and “big picture” water issues. The second will be devoted to water trading and other on-farm and irrigation district measures that can take advantage of climate forecasting. The first workshop is tentatively planned for March 26, 2004. We are actively planning the workshop activities at this time. Workshop planning documents are attached (Attachments 1, 2, 3).

Also under way is the writing of the background section for a journal article that will discuss the workshop findings.

Attachment 1 . NOAA Workshops on Adaptation to Climate Change in the Farm and Water Sectors in the Yakima Valley of Washington State

Objectives for the First Workshop

Over the last decade, researchers at Battelle Pacific Northwest Division have been studying the impacts of multi-year climate variability on drought in the Yakima River Basin. Climatologists are continuously providing longer and more reliable forecasts (especially El Niño). As a result of our studies, and we believe that it may be possible to use these forecasts to develop better water management strategies that can reduce the impacts of drought in the Yakima Valley. The National Oceanic and Atmospheric Administration has funded Battelle to hold a series of four one-day workshops with selected Yakima River basin water managers, irrigators, and other water users to help NOAA provide forecasts in the manner of greatest value to these potential users of their improved forecasts

Specifically, in the first workshop,

- A. From Battelle scientists, the workshop participants will learn the relationship between El Niño and other global-scale climate events with the occurrence of drought in the Yakima Valley, and the current ability of climatologists and hydrologists to forecast these low-water conditions. We will also describe the format of climate forecasts and explain the potential value of using these forecasts to manage the river
- B. The participants will have a chance to describe the impacts of climate variability and drought on water management decisions they have to make and what information they rely on to make these decisions
- C. The participants will be given the chance to divide into small teams to compete at “operating” the Yakima River (making storage decisions, doing water releases) using different operating rules of their own choosing. Each group will be able to decide whether and how to utilize (hypothetical) climate forecasts to guide their actions. In this way, they can painlessly experience the different risks involved under different operating regimes, and whether there is any benefit to using forecasts. A small prize will be awarded to the competing team with “best” plan (the one that poses the fewest problems for water users).

Later workshops are being planned to:

- Investigate water trading and other on-farm measures that could exploit climate forecasts
- Exchange lessons from climate variability about the potential impact of climate change in the Yakima Valley

- Demonstrate the role of additional storage with current climate variability and climate change

Attachment 2. NOAA Workshops on Adaptation to Climate Change in the Farm and Water Sectors in the Yakima Valley of Washington State

The tasks involved in planning for, conducting, and following up on these workshops are outlined below.

Task 1: Planning and Preparation

- ◆ Establish the specific purpose and goals for each workshop in the series
 - Focus on adaptation to climate change in farm and water sectors
 - Build on previous work re utilization of scientific information and forecasts
 - Apply EPA STAR grant regional modeling results
 - Use convergence and collaborative learning approach
 - Develop progression from first to last workshop
 - Work with same set of stakeholders over the four workshops
 - Use results of the first workshop to develop information for the second, and so on
 - Design workshops to progress through the farm and water management “year”
 - Design workshops around theme of “plans to adapt,” exploring use of climate forecasts and modeling tools and local knowledge about institutional processes and constraints related to *water storage and irrigation*
- ◆ Develop district-level vulnerability assessments and alternative drought mitigation strategies (e.g., modification of rule curves; construction of additional storage)
- ◆ Identify and recruit stakeholders to be included in the first workshop
 - Approach: Opportunistic selection of knowledgeable stakeholders who are farm and water management problem holders/decision makers in the Yakima Valley irrigation districts and interested in issues related to water storage and irrigation
 - Identification/selection process: Snowball technique starting with past and current participants in the Tri-County Water Resource Agency to develop a candidate participant list using both positional and reputational criteria
 - Recruitment process: Establish target date and location for workshop (Heritage College); telephone candidates to invite (modify date if necessary), followed by letter of invitation that includes statement about voluntary nature of participation
 - Informed consent process: Develop/obtain currently approved consent form from Human Subjects Review Board to be administered to participants at beginning of workshop.
- ◆ Develop first workshop agenda and informational and interactive materials
 - Workshop problem focus: *Using vulnerability assessments, climate forecasts, and modeling tools to plan best adaptation to **existing** institutional structures (e.g., water-rights leasing; entitlements, etc.) and water storage and irrigation facilities and resources*
 - Refine problem focus in consultation with key stakeholders
 - Validate hands-on practicum approach with key stakeholders
 - Develop first workshop agenda (See Attachment A)
 - Prepare read-ahead materials for workshop participants

- Prepare informational and interactive materials to be used during the workshop
- Prepare information use documenting and reporting tools
- ◆ Arrange logistics for workshop

Task 2: Conduct Workshop One (See Attachment A: Preliminary Workshop Agenda)

- ◆ Manage and facilitate workshop interactions
- ◆ Take notes during the meeting
- ◆ Assist participants as needed during the workshop

Task 3: Workshop Documentation/Report

- ◆ Assemble informational materials
- ◆ Summarize workshop discussions, information use, and plan characteristics
- ◆ Identify shared data needs

Task 4: Preparation for Second Workshop

Attachment 3. Preliminary Workshop Agenda

- 8:00-8:30 Continental breakfast, informal greetings
- 8:30-9:00 Introductions-- Mike Scott reviews purpose and agenda; round robin introductions; human subject informed consent process
- 9:00-9:30 Presentation 1: Ruby Leung: Climate Modeling – Translating NOAA forecasts into seasonal water availability estimates
--Purpose
--Scope/Topic
--Research Methodology
--Theoretical Basis/Framework
--Key data elements and sources
--Examples/highlights of results
--Key findings
--Issues/problems/limitations
--Opportunities
--Application to farm and water management
- 9:30-9:45 Discussion of climate modeling
- 9:45-10:15 Presentation 2: Lance Vail: Hydrologic Modeling – Translating NOAA forecasts into seasonal water availability estimates
--Purpose
--Scope/Topic
--Research Methodology
--Theoretical Basis/Framework
--Key data elements and sources
--Examples/highlights of results
--Key findings
--Issues/problems/limitations
--Opportunities
--Application to farm and water management
- 10:15-10:30 Discussion of hydrologic modeling
- 10:30-10:45 BREAK
- 10:45-11:15 Description of small group exercise and assignments to small groups
-- Purpose (develop adaptive plan) and approach
-- Explanation of scenarios and analytic tools
-- Information use monitoring procedures

- Plan template and best plan competition
- Report-out process and expectations
- 11:15-11:30 Small group organizing meeting
 - Role-playing assignments (water manager, junior water rights holder, senior water rights holder, wildlife manager, recreationist)
 - Review of scenarios and analytic tools
 - Walk through of the plan “template”
 - Small group report-out assignments
- 11:30-12:15 Small group exercise: Coping with climate forecasts
- 12:15-1:15 Working lunch (informal discussion)
- 1:15-2:30 Small group exercise (continued): Coping with climate forecasts
- 2:30-3:30 Small group presentation of plans and discussion (30 minutes per group, including questions and discussion)
 - Plan (walk through template)
 - Rationale
 - Key issues/tradeoffs
 - Discussion of institutional/jurisdictional issues
 - Team’s assessment of quality, pertinence, accessibility, and clarity of information provided and identification of useful information that was not provided
- 3:30-3:45 BREAK
- 3:45-4:45 Small group presentation of plans
- 4:45-5:00 Wrap up
 - Vote on “best plan”
 - Award prize to winning team members
 - Summary of accomplishments
 - Follow-up procedures and opportunities
 - Thanks

END FIRST CONFERENCE